BIBLIOGRAPHY

BANGKIKO, REY B. MAY, 2013. Efficacy of Mokusaku Against Selected Major Diseases Affecting Highland Vegetables. Benguet State University, La Trinidad, Benguet.

Adviser: Jocelyn C. Perez, MSc.

ABSTRACT

This first study was conducted under laboratory condition to evaluate the efficacy of Mokusaku against selected major vegetable diseases based on fermentation ages of mokusaku from one month to six months of age against *Xanthomonas campestris, Ralstonia solanacearum, Pectobacterium carotovorum*, *Alternaria porri* and *Fusarium oxysporum*. No inhibitory effect on bacteria and fungus was observed except for the positive control (Streptomycin) against *Xanthomonas campestris* and *Ralstonia solanacearum*.

The second study evaluated was the effect of different sources of mokusaku (bamboo, coconut husk, gmelina and jackfruit) on selected major diseases like *Fusarium oxysporum, Ralstonia solanacearum, Xanthomonas campestris* and postharvest disease *Pectobacterium carotovorum* which are contributory to yield losses of highland vegetables. Bioassay results showed no inhibition zone of different sources of mokusaku against *Fusarium oxysporum*, but were effective against pathogenic bacteria like *Ralstonia solanacearum, Xanthomonas campestris* and postharvest disease *Pectobacterium carotovorum.*

RESULTS AND DISCUSSION

Study 1. The effectiveness of wood vinegar as a treatment was tested on five diseases, namely; *Xanthomonas campestris*, *Ralstonia solanacearum*, *Fusarium oxysporum*, *Alternaria porri* and *Colletotrichum capsici.*

Inhibition Zone of Two Bacterial Diseases at 24 hours

Table 1 shows the inhibition zone of different fermentation ages against two bacterial diseases does not gave a comparable result against streptomycin (positive control) at 24 hours.

Table 1. Mean of inhibition zone on different bacteria at 24 hours

TREAMENT	MEANS	
	Xanthomonas	*Ralstonia*
T_1 Sterile distilled water	0^b	0^b
T_2 Streptomycin	2.125^a	7.5^a
T_3 One month old mokusaku	0^b	0^b
T_4 Two months old mokusaku	0^b	0^b
T_5 Three months old mokusaku	0^b	0^b
T_6 Four months old mokusaku	0^b	0^b
T_7 Five months old mokusaku	0^b	0^b
T_8 Six months old mokusaku	0^b	0^b

* Mean with the same letter do not differ at 5% DMRT

Inhibition Zone of Two Bacterial Diseases at 48 hours

Table 2 shows the inhibition zone of different fermentation ages against two bacterial diseases does not gave a comparable result against streptomycin (positive control) at 48 hours.

No inhibition zone in all of the treatments was observed against *Fusarium oxysporum, Colletotrichum capsici* and *Alternaria porri.*

Table 2.Mean of inhibition zone on different bacteria at 48 hours

TREAMENT	MEANS	
	Xanthomonas	*Ralstonia*
T_1 Sterile distilled water	0^b	0^b
T_2 Streptomycin	2.257^a	8.29^a
T_3 One month old mokusaku	0^b	0^b
T_4 Two months old mokusaku	0^b	0^b
T_5 Three months old mokusaku	0^b	0^b
T_6 Four months old mokusaku	0^b	0^b
T_7 Five months old mokusaku	0^b	0^b
T_8 Six months old mokusaku	0^b	0^b

* Mean with the same letter do not differ at 5% DMRT

Study 2. The effectiveness of wood vinegar as a treatment (Fig. 1) was tested on four major plant pathogens, namely; *Fusarium oxysporum*, *Xanthomonas campestris, Ralstonia solanacearum* and *Pectobacterium carotovorum*.

Inhibition Zone of Three Bacterial Diseases at 24 Hours

The use of bamboo, coconut husk, gmelina and jackfruit does not give comparable inhibition zone against streptomycin for *Xanthomonas campestris* (Fig. 3). The use of coconut husk mokusaku (Fig. 1-b) and bamboo (Fig. 1-a) gave comparable inhibition zone against *Ralstonia solanacearum* as compared to the positive control, streptomycin as shown in Table 3. For *Pectobacterium carotovorum*, bamboo vinegar gave a wider inhibition zone compared to the streptomycin (positive control).

Table 3.Mean of inhibition zone on different bacteria at 24 hours (mm)

TREAMENT	MEANS		
	Xanthomonas	*Ralstonia*	*Pectobacterium*
T_1 Sterile distilled water	0^{d}	0^{d}	0^{e}
T_2 Streptomycin	8.00^{a}	6.84^{a}	9.08^{abcd}
T_3 Bamboo vinegar	3.42^{c}	6.42^{ab}	10.34^{a}
T_4 Coconut husk vinegar	5.50^{b}	5.86^{abc}	9.92^{ab}
T_5 Gmelina vinegar	6.33^{ab}	5.17^{bc}	9.08^{abcd}
T_6 Jackfruit vinegar	5.25^{b}	4.25^{c}	9.25^{abc}

* Mean with the same letter do not differ at 5% DMRT

Inhibition Zone of Three Bacterial Diseases at 48 Hours

Results showed in Table 4 the inhibitory effects of the wood vinegar against bacterial pathogens after forty-eight hours. The use of bamboo, coconut husk, gmelina and jackfruit does not give comparable inhibition zone against streptomycin (positive control) for *Xanthomonas campestris*. For *Ralstonia solanacearum*, bamboo vinegar gave a comparable effect with the positive control, streptomycin. Streptomycin and coconut husk gave a significant result against *Pectobacterium carotovorum* at 48 hours, meanwhile at 48 hours inhibition zone (Fig. 8) of *Pectobacterium carotovorum* slightly decrease, and indicates that mokusaku is more effective at 24 hours (Fig. 7).

No inhibition zone in all of the treatments was observed against *Fusarium oxysporum* (Fig. 2). Mokusaku was reported to not be highly active extract against sap staining fungi (Velmurugan *et al*., 2008)

Table 4.Mean of inhibition zone on different bacteria at 48 hours (mm)

TREAMENT	MEANS		
	Xanthomonas	*Ralstonia*	*Pectobacterium*
T_1 Sterile distilled water	0^{e}	0^{e}	0^{d}
T_2 Streptomycin	8.58^{a}	7.92^{a}	9.17^{a}
T_3 Bamboo vinegar	3.58^{d}	7.25^{ab}	3.59^{bc}
T_4 Coconut husk vinegar	5.83^{bc}	6.09^{bc}	6.92^{a}
T_5 Gmelina vinegar	6.67^{b}	5.92^{cd}	3.00^{bc}
T_6 Jackfruit vinegar	5.25^{c}	4.75^{d}	4.25^{b}

* Mean with the same letter do not differ at 5% DMRT

a. b c. d

Figure 1. Treatments (a) Bamboo vinegar, (b) Coconut husk vinegar, (c) Gmelina vinegar and (d) Jackfruit vinegar

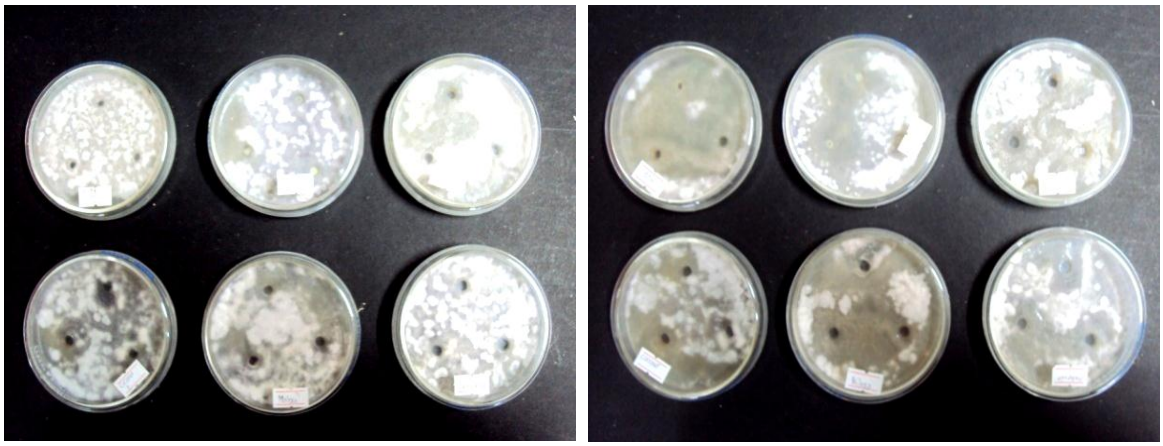

Figure 2. Inhibition zone of *Fusarium oxysporum* at seven days (a) plate 1 and (b) plate 2

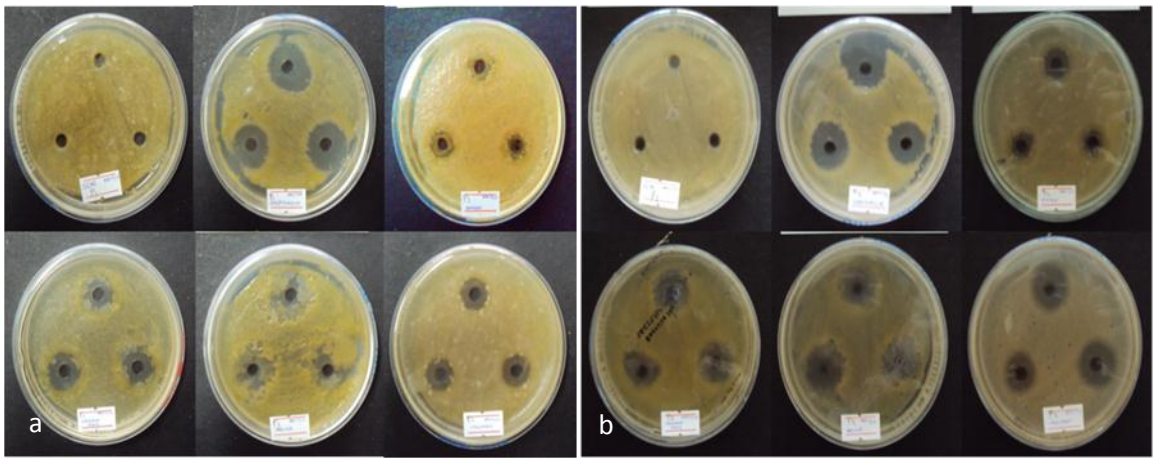

Figure 3. Inhibition zone of *Xanthomonas campestris* at forty eight hours (a) plate 1 and (b) plate 2

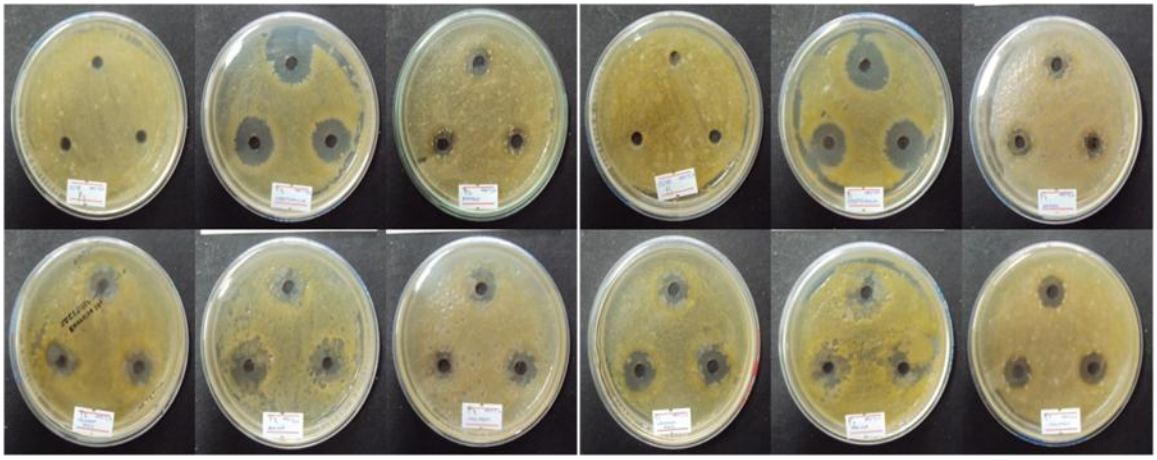

Figure 4. Inhibition zone of *Xanthomonas campestris* at forty eight hours (a) plate 1 and (b) plate 2

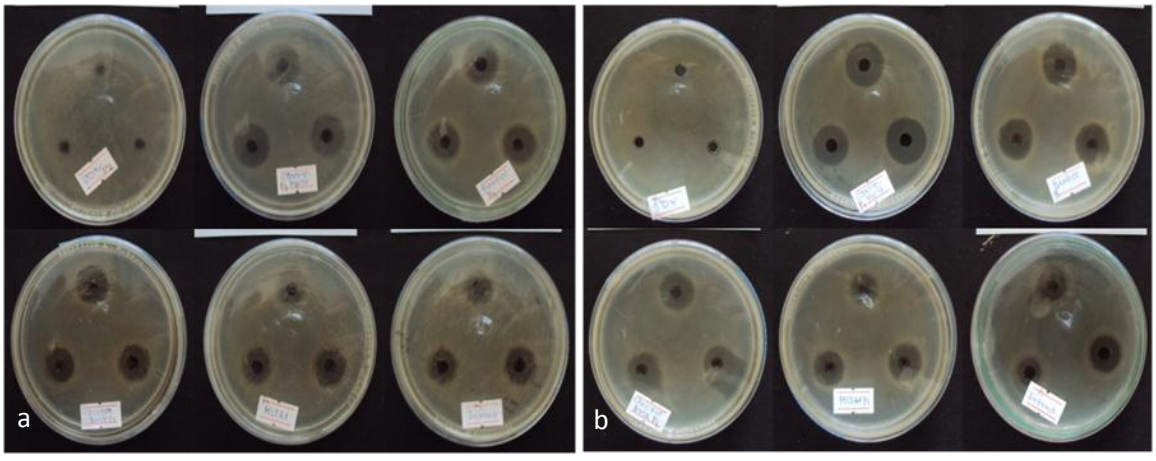

Figure 5. Inhibition zone of *Ralstonia solanacearum* at twenty four hours (a) plate 1 and (b) plate

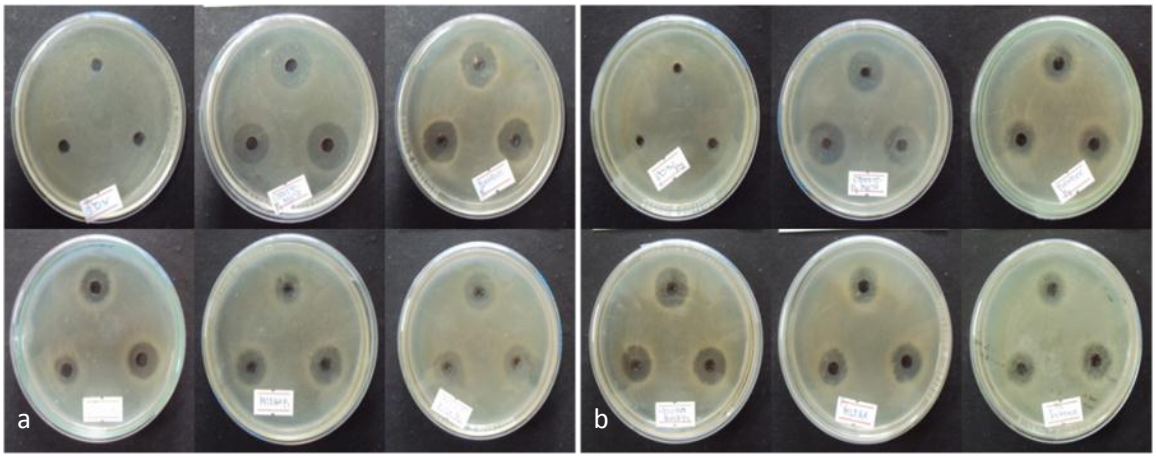

Figure 6. Inhibition zone of *Ralstonia solanacearum* at forty eight hours (a) plate1 and (b) plate 2

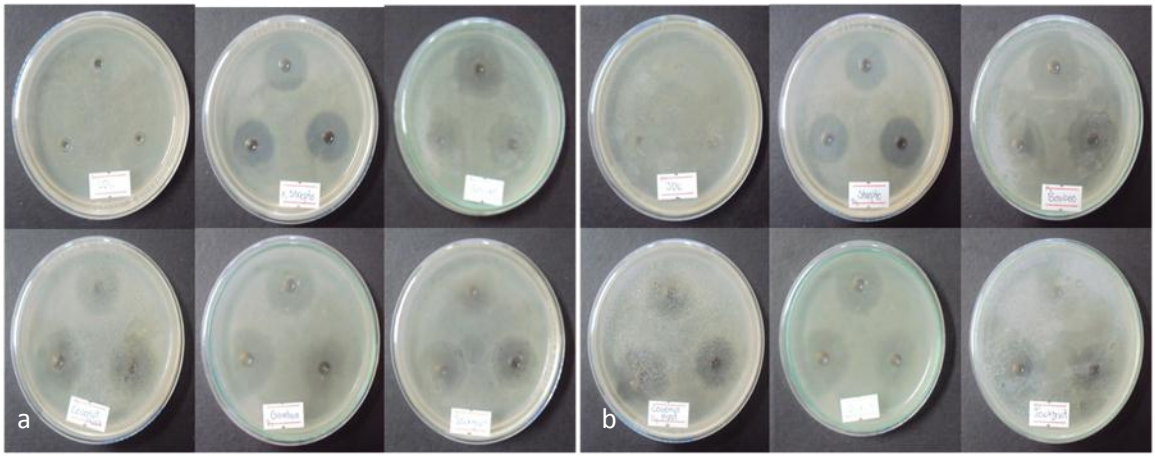

Figure 7. Inhibition zone of *Pectobacterium carotovorum* at twenty four hours (a) plate1 and (b) plate 2

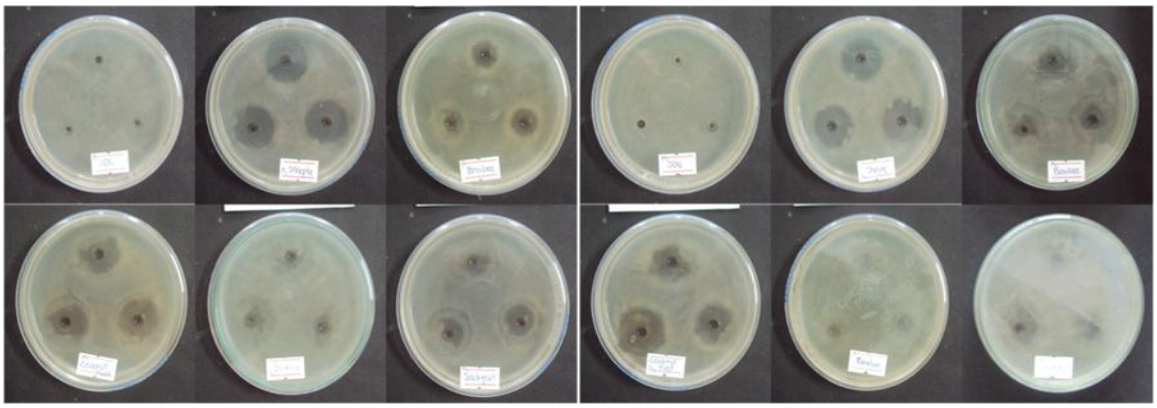

Figure 8.Inhibition zone of *Pectobacterium carotovorum* at forty eight hours (a) plate 1 and (b) plate 2

pH of Different Sources of Mokusaku

All of the mokusaku shows varying effects on the specimens (*Ralstonia solanacearum, Pectobacterium carotovorum, Xanthomonas campestris* and *Fusarium oxysporum.* Among all the mokusaku sources, Gmelina vinegar is more acidic compared to the other vinegars. In addition mokusaku are acidic, the effect of mokusaku pH on the ionization of the phenolic compounds at pH 3.0, phenolic hydroxyl groups are ionized and antioxidant activities of mokusaku (Bortolomeazzi *et al*., 2007). This study is collaborated to the study of (Flower, CP. 1996) that the acidity of mokusaku had an effect to bacteria.

Table 5.pH of Different Sources of Mokusaku

Sources of Mokusaku	pH
Bamboo vinegar	3.47
Coconut husk vinegar	3.60
Gmelina vinegar	3.42
Jackfruit vinegar	3.74

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The first study was conducted to evaluate the efficacy of different ages and sources of Mokusaku against selected major highland disease under laboratory condition. Treatments used for the first study were based on fermentation ages from one month to six months of age. No inhibitory effects were observed on *Ralstonia solanacearum, Xanthomonas campestris, Alternaria porri, Colletotrichum capsici and Fusarium oxysporum* except for the check chemical (streptomycin) on bacterial pathogens.

Second study, treatments used was based on mokusaku sources like bamboo vinegar, coconut husk vinegar, gmelina vinegar and jackfruit vinegar. Results of the study showed that the different sources of mokusaku had a varying effect against *Xanthomonas campestris, Ralstonia solanacearum* and *Pectobacterium carotovorum* but no inhibitory effect against *Fusarium oxysporum*. Results for twenty four hours of incubation, the inhibition zone of *Ralstonia solanacearum* and *Xanthomonas campestris* slightly increased after forty eight hours. For *Pectobacterium carotovorum* the inhibition zones decreases after forty eight hours.

Conclusion

Different sources of mokusaku had a varying effects on bacterial pathogens; *Xanthomonas campestris, Pectobacterium carotovorum* and *Ralstonia solanacearum*.

Recommendation

Follow-up experiments needs to be conducted to confirm the results obtained from this study. This study under laboratory condition could be tested under field condition.

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